


3-4

Linear Functions

What You'll Learn

To recognize linear functions and use tables and equations to graph them

 **New Vocabulary** linear function, discrete data, continuous data

CONTENT STANDARDS

8.F.3

Why Learn This?

When you turn on a faucet or hose, the rate that the water comes out can be modeled with a linear function.

People fill things with liquid every day like gas tanks, watering cans, and swimming pools. If the liquid enters the container at a constant rate, then there is a linear function that relates time and the amount of liquid in the container.



A **linear function** is a function whose points lie on a straight line when the function is graphed. There are many ways to determine if a function is linear. One way is to use a table. If the ratios between the changes in variables in a table are the same, then the function is linear.

EXAMPLE**Linear Functions in Tables**

- 1 Determine which function represented by a table is linear.

Function 1

		+1	+1	+1
x	1	2	3	4
y	6	8	10	14
		+2	+2	+4

The ratios between the changes in variables are $\frac{1}{2}$, $\frac{1}{2}$, and $\frac{1}{4}$. The ratios are *not* the same so the function is *not* linear.

Function 2

		-1	-2	-3
x	2	1	-1	-4
y	-6	-3	3	12
		+3	+6	+9

The ratios between the changes in variables are all $-\frac{1}{3}$, $-\frac{2}{6}$, and $-\frac{3}{9}$ which all simplify to $-\frac{1}{3}$. The ratios are the same so the function is linear.

Function 2 is linear since the ratios between the changes in variables are the same.

Examples

- 1 **Linear Functions in Tables** Determine which function represented by a table is linear.

Function 1

Find the changes in variables.

		+2	+2	+2
x	-2	0	2	4
y	4	7	10	16
		+3	+3	+6

Ratios in changes between variables:

$$\frac{2}{3}, \frac{2}{3}, \frac{1}{3}$$

The ratios are **not the same**, so the function **is not** linear.

Function 2

		+2	+2	+2
x	3	5	9	15
y	10	6	-2	-18
		-4	-8	-16

Ratios in changes between variables:

$$-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}$$

The ratios are **the same**, so the function **is** linear.



Additional Examples

- 1 Determine which function represented by a table is linear.

Function 1				
x	2	3	6	10
y	4	6	12	22

Function 2				
x	4	5	6	7
y	16	20	24	28



Table Talk about this question.

Quick Check

1. Determine if the function represented in the table is linear. Explain.

x	5	9	17	21
y	-12	-13	-15	-16



Write all of this screen into your notes please.

Discrete data are data that involve a count of items, such as numbers of people or cars. For discrete data, plot the data points and connect them with a dashed line. **Continuous data** are data where numbers between any two data values have meaning. Use a solid line to indicate continuous data.

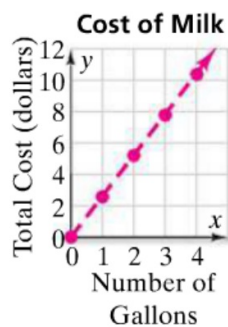
EXAMPLE Graphing Discrete Data

2 Groceries A gallon of milk costs \$2.59. The total cost of g gallons of milk is a function of the price of one gallon. Make a table and graph the function.

Step 1 Determine whether the data are discrete or continuous. You cannot buy part of a gallon container, so the data are discrete.

Step 2 Make a table. Connect the points with a dashed line.

Number of Gallons	Total Cost (dollars)
1	\$2.59
2	\$5.18
3	\$7.77
4	\$10.36



Vocabulary Tip

A dashed line in a graph means that not every point on the graph satisfies the conditions of the problem.

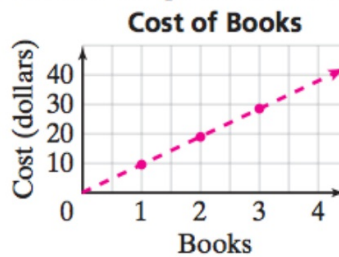
- 2 **Graphing Discrete Data** It costs \$9.50 to download a book to an e-reader. The total cost of downloading books is a function of the price of one book. Make a table and graph the function. Determine whether the data are discrete or continuous.

You **cannot** buy part of a book, so the data are **discrete**.

Complete the table.

Number of Books	Total Cost (dollars)
0	0.00
1	9.50
2	19.00
3	28.50

Connect data points with a dashed line.

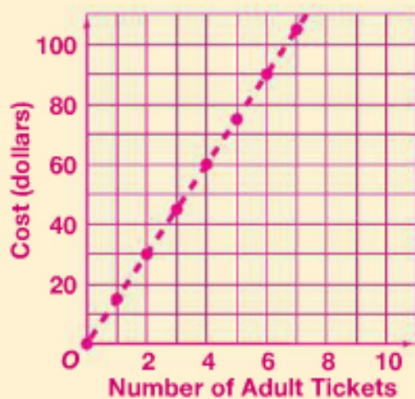


Quick Check

2. **Tickets** The function $c = 15t$ represents the cost (in dollars) of t adult tickets to a museum. Make a table and graph the function.

2.

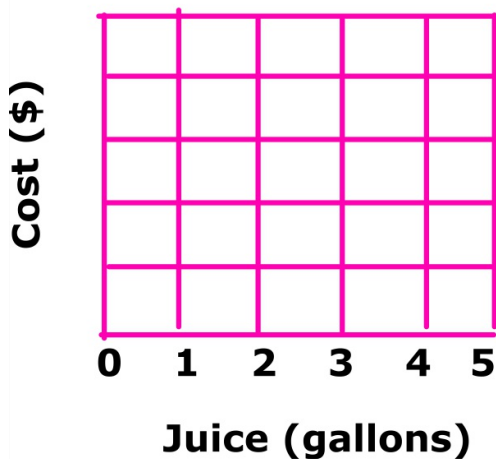
Tickets	0	1	2	3	4	5	6	7
Cost	0	15	30	45	60	75	90	105



Pay attention to how the table relates to the graph. **Talk at your tables** about which row of the table is labeled at the bottom of the graph, and which row is labeled at the side of the graph.

- 2 Juice costs \$2.19 per gallon. The total cost of g gallons is a function of the price of a single gallon. Make a table and graph.

Input g	1	2	3
Output \$			



TALK AT YOUR TABLE ABOUT HOW TO COMPLETE THE TABLE, AND HOW TO GRAPH THE FUNCTION.

EXAMPLE Graphing Continuous Data

- 3 **Fitness** Xin lifted weights and burned 100 calories. Then she walked and burned 257 calories per hour. The function $c = 257h + 100$ gives the total calories Xin burned where c represents calories and h represents hours walking. Use the equation to make a table and graph the function.

Xin can walk for part of an hour, so the data is continuous. Plot the data and connect the data points with a solid line.

Time (hours)	Number of Calories
0	100
1	357
2	614
3	871



- E Graphing Continuous Data** A shopper buys some grapes that cost \$2.19 per pound and a watermelon that costs \$4.00. The function $c = 2.19p + 4$ gives the total the shopper spent on produce where c represents total cost and p represents number of pounds of grapes. Use the equation to make a table and graph the function.

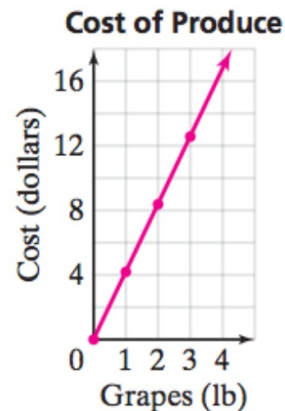
Determine whether the data are discrete or continuous.

You can buy part of a pound of grapes, so the data are continuous.

Complete the table.

Pounds of Grapes	Total Cost (dollars)
0	0.00
1	4.19
2	8.38
3	10.57

Connect data points with a solid line.



Quick Check

- 3. Flying** The function $a = 4,000 - 600m$ gives the altitude a of a plane in feet after m minutes. Make a table and graph the function.

3.

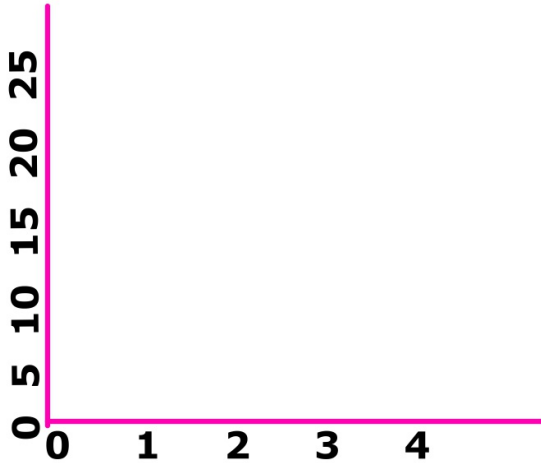
Time	0	1	2	3	4	5	6
Height	4,000	3,400	2,800	2,200	1,600	1,000	400



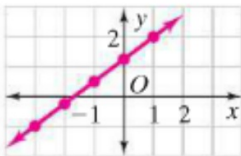
Talk at your tables about whether this example follows the same pattern placing the data on the graph as the last example.

3 Amber earns \$7 per hour. The function $e = 7h$ gives Amber's total earnings e in dollars for the number of hours h she works. Use the equation to make an input-output table and graph the function.

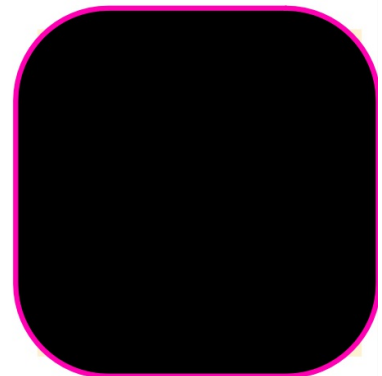
Input (hours)	0	1	2	3	4
Output (\$)					



Check Your Understanding



- Vocabulary** Explain how you can use a table that represents a function to determine if the function is linear.
- Does the graph at the left show discrete or continuous data?
- Make a table for the function $d = 3t$ which gives the distance traveled at the rate of 3 mi per hr. Then graph the function.



You have an assignment worksheet.

Name _____ Class _____ Date _____

Practice 3-4

Linear Functions

Determine if the function represented by the table is linear. Explain.

1.

x	3	5	7	11
y	6	9	12	18

2.

x	-4	-1	5	12
y	3	7	15	23

3.

x	6	0	-9	-12
y	-2	8	23	28

4.

x	-1	5	12	18
y	72	12	2	0

5.

x	84	5	-1	-4
y	1	-1	-5	-9

6.

x	25	15	0	-10
y	16	8	-4	-12

Determine whether the data for each function are *discrete* or *continuous*. Then make a table and graph for the function.

7. The function $f = 1.5h + 6$ represents the height (in inches) of water in a pool that contained 6 inches of water before the refilling began.

8. The function $c = 2.25b - 0.5$ represents the cost (in dollars) of b beverages at a snack bar after using a coupon.

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